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(54) TITLE OF THE INVENTION:

LUBRICATION APPARATUS FOR ROCKER ARM CHAMBER

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SPECIFICATION

1. TITLE OF THE INVENTION

LUBRICATION APPARATUS FOR ROCKER ARM CHAMBER

2. WHAT IS CLAIMED IS:

(1) A lubrication apparatus for circulating oil stored in a crank chamber to a rocker arm chamber via an oil supply path and a return path, wherein the return path on the crank chamber side is opened and closed by a motion of a tappet, and wherein when the pressure in the crank chamber is lower than the atmospheric pressure, the return path is opened so as to promote the return rate of the oil making use of the lower pressure in the crank chamber.

(2) The lubrication apparatus according to claim 1, wherein a check valve is provided to the oil supply path in order to allow oil flow from the crank chamber to the rocker arm chamber.

3. DETAILED DESCRIPTION OF THE INVENTION

[Field of the Industrial Utility]

The present invention relates to a structure of a lubrication apparatus for lubricating a rocker arm chamber of an overhead-valve (OHV) engine.

[Description of Prior Art]

In overhead-valve engines, an induction valve and an exhaust valve are positioned directly above the combustion chamber, and the rocker arm for activating these valves is also provided above the cylinder head. Thus, the rocker arm chamber in which the valve activation mechanism, including the rocker arm, is accommodated is formed above the cylinder head.

The rocker arm chamber is generally defined inside the head cover which encloses the motional components including a bearing, which is the center of the swing of the rocker arm, an abutment between the rocker arm and the valve stem, and a valve guide for guiding the valve stem in a slidable manner. Since these motional components must be lubricated, a lubrication apparatus for the rocker arm chamber is used.

However, since in the overhead-valve engine the rocker arm chamber is located above the engine, apart from the crank chamber, the rocker arm chamber can not be reliably lubricated by a conventional lubrication method in which an oil flow path is formed and the oil in the crank chamber is paddled and splashed into the rocker arm chamber.

In order to overcome this problem, adding an oil pump to the engine has been proposed and actually employed. However, since this technique requires an extra oil pump and a driving mechanism, the engine structure inevitably becomes large and complicated, which results in the increased manufacturing cost and inconvenience in maintenance.

[Objective of the Invention]

Therefore, it is an object of the invention to overcome these problems in the prior art, and to provide a lubrication apparatus which can reliably lubricate the rocker arm chamber with a simple structure.

[Summary of the Invention]

The above-mentioned object is achieved by providing an oil supply path and a return path between a crank chamber and a rocker arm chamber, and opening the return path by a motion of a tappet when the pressure in the crank chamber is lower than the atmospheric pressure, thereby promoting the return rate of oil making use of the suction due to the lower pressure.

In particular, a lubrication apparatus for circulating oil stored in a crank chamber to a rocker arm chamber via a oil supply path and a return path is provided according to the invention. The return path on the crank chamber side is opened and closed by a motion of a tappet. When the pressure in the crank chamber is lower than the atmospheric pressure, the return path is opened so as to promote the return rate of the oil making use of the lower pressure in the crank chamber.

[Preferred Embodiment]

The preferred embodiment of the invention will be described in detail with reference to the attached drawings.

Fig. 1 illustrates an overhead-valve engine having a lubrication apparatus for rocker arm chamber according to an embodiment of the invention. One end of a coupling rod 3 is connected to a crank shaft 2 received by a crank case 1A which defines a crank chamber 1. The other end (i.e., the narrower end) of the coupling rod 3 is connected to a piston 5 which is fit into a cylinder 4.

The top face of the cylinder 4 is connected a cylinder head 6 in an air-tight manner, and a combustion chamber 7 is formed in the connected portion between the cylinder 4 and the cylinder head 6. An induction path 8 and an exhaust path 9 are also formed in the cylinder head 6, and an induction valve 10 (not shown) and an exhaust valve 11 are fit into the cylinder head 6 in a slidable manner in order to open and close the openings (or the ports) of the induction path 8 and the exhaust path 9 which communicate with the combustion chamber 7. A pair of rocker arms 14 are supported by a shaft in a pivotable manner on the cylinder head 6. The rocker arms 14 move the induction valve 10 and the exhaust valve 11 toward the open positions against the valve spring 13.

A head cover 15 is put on the cylinder head 6 in an air-tight manner so as to enclose the pair of rocker arms 14, and a rocker arm chamber 16 is formed inside the head cover 15.

In the lower part, a cam shaft 17 extends in parallel to the crank shaft 2, and is received by the crank case 1A. The cam shaft is rotated via a cam gear 18 at an angular velocity of one half (1/2) of the crank shaft 2.

A pair of tappets 20 and a pair of push rods 21, which are reciprocated by a cam, are provided between the cam surfaces 19 of the cam shaft 17 and the rocker arms 14 so as to drive the rocker arms 14 at a predetermined timing. Each rocker arm 14 corresponds to one of the induction valve and the exhaust valve, and each cam surface 19, tappet 20 and push rod 21 are associated with one of the rocker arms 14. The induction valve 10 and the exhaust valve 11 are opened at a predetermined timing during the engine stroke (or the rotation of the crank) according to the revolution of the engine, that is, the rotation of the crank shaft 2, whereby the induction and exhaust operations are performed.

The crank chamber 1 contains lubrication oil 22 up to a predetermined height. The oil 22 is paddled and splashed by the

oil splasher 23 which is fixed to the crank shaft 2 in order to lubricate a desired part, such as the broader end of the crank.

Next, the lubrication apparatus for the rocker arm chamber 16 will be described below.

An oil supply path 24 and a return path 25 are formed in the cylinder 4 and the cylinder head 6.

The crank shaft 2 is rotated in the direction indicated by the arrow A, and the cam shaft 17 is rotated in the opposite direction indicated by the arrow B.

The opening (i.e.., the entrance) 26 on the crank chamber side of the oil supply path 24 is located at a position to which the oil 22 paddled and splashed by the oil splasher 23 directs. The other end of the oil supply path 24 is opened in the rocker arm chamber 16. A check valve 27 which allows the oil flow only in the direction to the rocker arm chamber 16 is provided in the middle of the oil supply path 24. In the example shown in Fig. 1, the check valve 27 is provided at the connection part between the cylinder 4 and the cylinder head 6.

The return path 25 is a path, through which the oil returns to the crank chamber 1 from the rocker arm chamber 16. The end portion 28 on the crank chamber side is opened toward the bearing face, into which the tappet (for the exhaust valve in the example shown in Fig. 1) 20 is fit. A groove 29 is formed on the surface of the tappet 20 along the axial direction. The aperture 28 on the crank chamber side of the return path 25 is opened and closed by the motion of the tappet 20 in the axial direction. In other words, the connection and disconnection between the return path 25 and the crank chamber 1 is controlled by the position of the tappet 20.

Fig. 2 is a graph showing the relation between the variable pressure P in the crank chamber and the opening/closing timing of the return path 25 in a cycle (i.e., 4 strokes) of the engine.

As shown in Figs. 1 and 2, the tappet 20 for the exhaust valve moves upward during the opening period E of the exhaust valve, and reaches the maximum lifted position at a point θ_E almost in the middle of the period E. The groove 19 formed in this tappet 20 is designed so that the groove 19 is in communication with the return path 25 within a predetermined range S centered on the maximum lifted pint θ_E, in which range the pressure P in the crank chamber becomes negative with respect to the atmospheric pressure. In the period other than this range S, the opening 28 is closed by the tappet 20.

Fig. 2 also shows Period G, in which the tappet for the induction valve is lifted.

In this fashion, the return path 25 on the crank chamber 28 side is opened and closed by the motion of the tappet 20. In particular, the return path 25 is in communication with the crank chamber 1 via the tappet 20 when the pressure P in the crank chamber 1 is negative with respect to the atmospheric pressure, thereby promoting the oil return rate making use of the suction force due to the negative pressure.

With this structure, oil 22 which is paddled and splashed by the oil splasher 23 during the driving moves upward via the oil supply path 24 with its kinetic energy, and reaches the rocker arm chamber 16. In this case, the check valve 27 provided in the middle of the oil supply path 24 can prevent the oil from returning to the crank chamber due to the gravity before it reaches the rocker arm chamber 16. The check valve 27 is forced in the opening direction when the pressure of the crank chamber 1 is positive with respect to the atmospheric pressure, and is forced in the closing direction at a negative pressure. Thus, the variable pressure P in the crank chamber 1 is efficiently used to promote the oil supply effect.

The oil supplied to the rocker arm chamber 16 lubricates

desired portions, for example, the swinging bearing of each rocker arm 14, pressurized contacting portions between the rocker arms 14 and the valves (induction and exhaust valves 10 and 11), and frictional portions between each valve stem and the valve guide 12. Then, the oil passes through the return path 25 and the groove 29 of the tappet 20, and returns to the crank chamber 1. Since the return path 25 is opened due to the motion of the tappet 20 when the pressure of the crank chamber 1 is negative, the oil return rate is promoted by the negative-pressure suction force.

Thus, the oil circulation to the rocker arm chamber 16 is improved by the pumping effect making use of the variable pressure P of the crank chamber, and inside the rocker arm room 16 is reliably lubricated.

In particular, the enhanced oil return structure in the return path 25 can prevent the oil from flowing into the combustion chamber 7 from the gap between the valve stem and the valve guide 12. As a result, oil consumption can be reduce, while undesirable white smoke can be eliminated, even if the engine is inclined.

This structure does not require an extra oil pump. Accordingly, lubrication of the rocker arm chamber can be reliably performed with a simple and compact structure, which yields further advantages, such as reduced manufacturing cost and facilitated maintenance.

Although, in the example shown in Fig. 2, the return path communicating period S is set so that the variable pressure P of the crank chamber is negative throughout the period S, a positive pressure range may be partially included in the return path communicating period S as long as the negative pressure is dominant over the positive pressure.

The return path 25 is opened and closed using the tappet 20 for the exhaust valve in the above-described embodiment. However, the tappet for the induction valve may also be used to open and

close the return path 25.

In addition, some or all of the oil supply path 24 and the return path 25 length can consist of a suitable pipe or the like. The embodiment in the drawings was explained using a horizontal shaft-type engine, but the invention can also be applied to a vertical shaft-type engine.

[Effect of the Invention]

As clarified in the explanation above, the invention is able to provide a lubrication apparatus with a simple, compact structure that is able to reliably lubricate a rocker arm chamber.

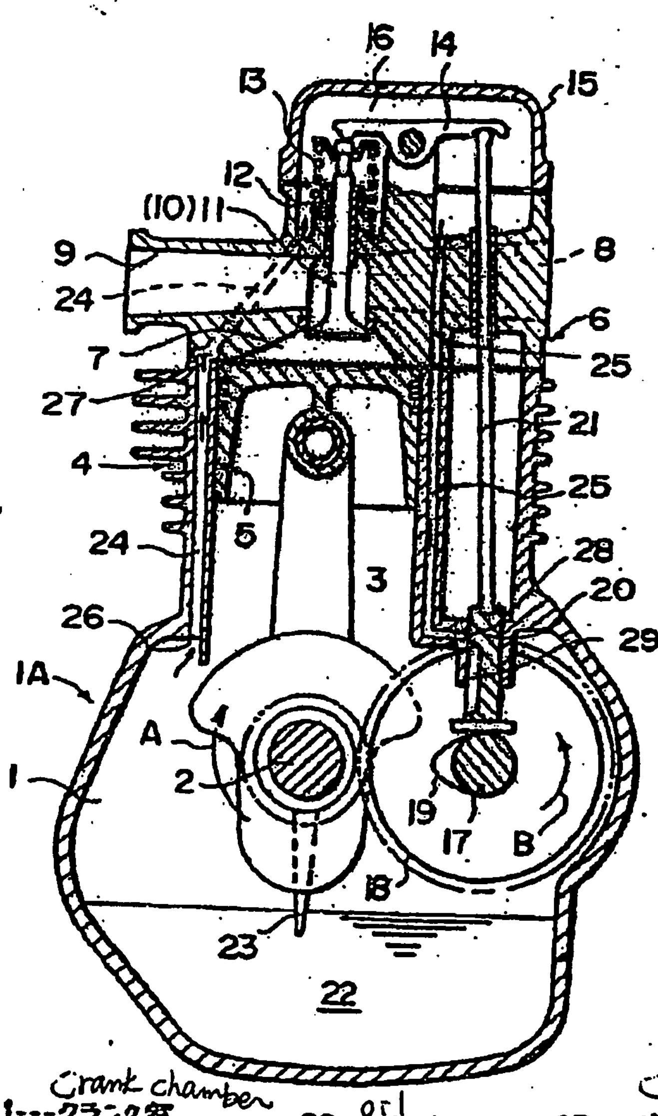
4. Brief Explanation of the Drawings

Fig. 1 illustrates an overhead-valve engine having a lubrication apparatus for a rocker arm chamber according to an embodiment of the invention. Fig. 2 is a graph showing the relation between the variable pressure P and the return path communication timing S based on the operation of the tappet in Fig. 1.

1 ... crank chamber	16 ... rocker arm chamber
17 ... cam shaft	20 ... tappet
21 ... push rod	22 ... oil
24 ... oil supply path	25 ... return path
27 ... check valve	29 ... groove

Agent Yasutaka Oto, Patent Attorney

第 1 図



Crank chamber
1---クランク室

16---ロッカーアーム室
rockerarm chamber

20---タペット
Tappet

oil
22---オイル

24---送油通路
Oil supply path

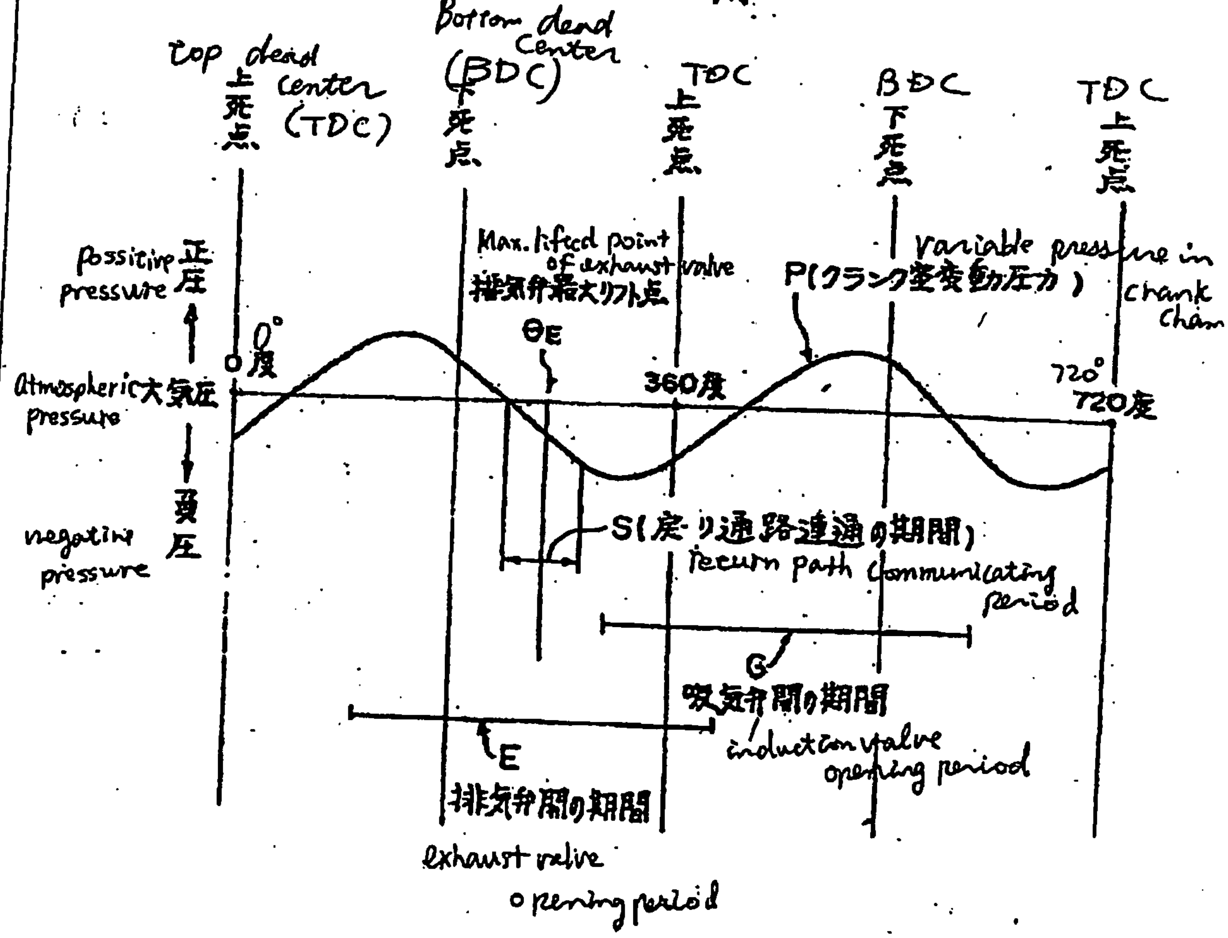
25---戻り通路
return path

Check valve
27---逆止弁

29---溝 groove

223

第 2 図



top dead center
上死点 (TDC)
Bottom dead center
(BDC)
下死点
TDC
上死点
BDC
下死点
TDC
上死点
possitive pressure 正圧
Atmospheric pressure 大気圧
negative pressure 負圧
0°
0度
360度
720°
720度
Max. lifted point of exhaust valve
排気弁最大リフト点
θE
P(クランク室変動圧力)
variable pressure in crank cham
S(戻り通路連通の期間)
return path communicating period
G
吸気弁開の期間
induction valve opening period
E
排気弁開の期間
exhaust valve opening period